BIOLOGICAL NOTES ON *CERCERIS BLAKEI* CRESSON (HYMENOPTERA: SPHECIDAE)

By Karl V. Krombein[1]

Cerceris blakei Cresson is one of the smallest species of *Cerceris* in the southeastern United States, females usually ranging in length from 7.5 to 9 mm. It is also one of the most abundant species of the genus in sandy areas. I have taken it in large numbers on the barrens at Kill Devil Hills, North Carolina, and from several areas with sandy soil in Florida. Label data on specimens in the U. S. National Museum and my personal collections indicate a flight range of at least March 29 to September 17 in peninsular Florida and May 24 to September 14 in coastal North Carolina, so undoubtedly there are two or three generations a year in both areas.

The observations which follow were made during a period of residence at the Archbold Biological Station, Lake Placid, Fla., June 17 to July 5, 1962. The actual observations were made in an area of gently rolling white-sand scrub adjacent to Lake Annie, just SW of the junction of State Roads 17 and 70, about a mile north of the Station property, and on the sparsely vegetated sand flats along the Peace River at Arcadia, about 35 miles west of the Station. The Lake Annie area had a sparse to moderately thick vegetative cover with grasses, *Leptoglottis,* and other sand-scrub plants, together with scattered scrub hickory, scrubby live oak, and scrub palmetto or bluebud, *Sabal Eltonia* Swingle. This palmetto has a lengthy blooming period; some plants were in fruit, others in bloom, and still others just in the early bud stage during my visit. I mention it particularly because the flowers were very attractive to the principal prey of the *Cerceris.*

The Florida population of *blakei* has darker wings, frequently reduced yellow markings on the abdomen, and the first two abdominal segments dull red. However, there is a clinal gradation toward the coastal North Carolina population which has lighter wings, well-developed yellow markings on the abdomen, and an absence, or reduction in the amount, of red on the basal segments.

Despite its abundance, I was unable to obtain any biological data on *blakei* during a number of visits to coastal North Carolina. In the Lake Annie area, however, at 0830 hours on June 23 I saw a female (62362 A) fly into her burrow near a grass tuft in an almost level area of bare sand. She flew out in a few seconds and returned

[1] Entomology Research Division, Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C.

half a minute later, at which time I netted her, took her prey, and freed her. The prey was a small (2.5 mm. long), rather slender, light-tan weevil, *Derelomus basalis* LeConte, having a castaneous bill and a small median blotch anteriorly on the elytra. This is a common weevil and has much the same range as the wasp which preys on it. Several minutes later I saw a second female *blakei* (62362 B) fly into her burrow near a fallen twig in a bare sandy area only ¾ meter from the nest of A. I took a *basalis* weevil from her on her next provisioning flight. The identity of both of the wasps was determined by hand-lens examination of the characteristic clypeal process and inflated tegulae. No other individuals were found in the immediate area on June 23, nor during the following 3 days while nest A was under observation.

The burrow entrances were about 3 mm. in diameter, and there was no spoil heap of excavated sand surrounding the entrances. If such a spoil heap existed, it was undoubtedly washed away by the heavy rains of the previous day or two.

I watched the provisioning flights of these two females during part of the morning and found that 11 provisioning flights of wasp A averaged 1¼ minutes (range 15 seconds to 3¼ minutes), and that she stayed in the burrow an average of 28 seconds (range 10–70 seconds) between flights. Wasp B worked a little slower or flew farther for prey, because 10 provisioning flights required an average of 2 minutes each (range 40 seconds to 3½ minutes); her periods in the burrow also averaged 28 seconds (range 10–55 seconds). So far as I could determine the wasp clutched the small weevil prey in her mandibles and flew directly and swiftly into the burrow. As is customary in *Cerceris, blakei* did not make a temporary closure when leaving the burrow. So far as I observed, *blakei* never made a temporary closure from within until she completed her hunting activities each day. When returning with prey, the wasps usually flew swiftly and directly toward the burrows, and only half a meter above the ground.

Wasp A always flew WSW when she left the burrow to hunt for prey, and B flew ESE. I was able to trace A to the source of her weevil prey, and found that she was visiting the flowers of a couple of scrub palmettos located 5–6 m. from her burrow. The *basalis* weevils were apparently visiting the flowers only, because I could find none on the buds or fruits of other palmetto plants. The weevils were quite abundant, and crawled fairly rapidly over the flower spikes, particularly on the stamens. Frequently a dozen could be seen on a single spike of bloom. The wasp flew from flower spike to spike and explored each on foot. Usually she found a weevil in only a few seconds, grasped it in her mandibles, and bent her abdomen underneath to sting it in the venter. Sometimes she would fly with the weevil to an adjacent palmetto leaf or grass blade before stinging it. At such times she clung to the leaf or grass blade with her mid and hind legs while stinging the weevil. The entire capture and stinging took only a few seconds, and then the wasp flew off straight to her burrow.

When I returned from lunch at 1330, both burrows were tightly closed from within, and I dug up that of wasp B. The sand was moist ½ cm. beneath the surface, and I found a solid plug of damp sand in the upper 9 cm. The burrow was perpendicular and 3 mm. in diameter. There was a holding cell immediately beneath the plug containing 39 paralyzed *basalis* weevils, 2.3–3.5 mm. long, interspersed among loose sand grains. The wasp flew out and escaped when I reached a depth of 15 cm. I continued the excavation to a depth of 30 cm. and the same diameter, but I found no provisioned cells. This nest probably was begun just the day before, because I watched wasp B bring in at least 17 weevils the morning of the 23rd.

On the following three days, June 24–26, I watched the nesting activities of wasp A during each morning. The nest entrance was already open when I arrived at 0755 on June 24. The air temperature in the shade was 83° F. at 0800 and had risen to 91° by noon. The wasp worked diligently and brought in 76 weevils between 0805 and 1151. Sixty-six of the provisioning flights averaged 58 seconds each, and ranged from 15 to 200 seconds. Seventy-one periods in the burrow averaged 23 seconds each and ranged from 5 to 75 seconds. All of her provisioning flights were toward the WSW, to the same palmetto plants visited the previous day, but periodically the wasp flew toward the NE and remained away for longer periods. Presumably these flights were made to obtain nectar, for I saw several female *blakei* visiting flowers of *Aldenella tenuifolia* (Torrey and Gray) Greene subsequently. When wasp A returned from these feeding (?) flights, she always flew in from WSW, so presumably she flew from her nectar source to the weevil source before returning to her nest. There were at least five feeding (?) flights on June 24, ranging from 4 to 51 minutes in duration. The longest one was made just prior to her closing the burrow from within at 1151. There were no other burrow closures during the morning, and the nest remained closed for the rest of the day.

There was an extremely heavy rain the evening of June 24, and wasp A did not open her burrow until 0928 on June 25. Her exit was impeded by several grass blades which had washed across the entrance. She flew off to the NE at 0930 (to feed ?) without making an orientation flight, and returned from SW with a weevil at 0943. Prior to her return I removed the grass blades and apparently loosened some of the sand at the entrance, because the wasp spent several minutes firming the sand around the upper part of the burrow after she deposited her first weevil in the nest. This day, wasp A worked until between 1330 to 1400, at which time the entrance was plugged from below. In the light of data obtained subsequently, it appears that wasp A worked for a long enough period each morning, approximately 4 hours, to obtain sufficient weevils to store one cell and then closed the burrow for the day. Fifty-six timed provisioning flights this morning ranged from 15 seconds to 2 minutes and averaged 52 seconds each. Sixty-three periods in the next averaged 21 seconds each, and ranged from 10 to 85 seconds. Again, the wasp made at least five flights to feed (?) ranging from 6½ to 14 minutes. Again this day she continued to exploit for prey the palmetto blooms 5–6 m. WSW of her nest.

There was no rain the evening of June 25, and wasp A was already bringing in weevils when I reached the nesting site at 0808 on June 26. For the next 10 minutes she continued flying WSW to obtain weevils, but then she started to fly S for prey. When I examined the palmetto she had been visiting earlier, I found that the blooming period was finished and that no weevils remained on the plant. The nearest blooming palmetto was now 18 m. S of the nest, and there were plenty of weevils on it. Thirty-four provisioning flights averaged 77 seconds each, and ranged from ½ to 4 minutes. Thirty-seven periods in the burrow averaged 23 seconds, and ranged from 10 to 80 seconds. I did not watch the wasp for the entire morning. However, it closed its burrow from within between 1130 and 1255.

This wasp (62362 A) was a very efficient huntress. Several periods of sustained provisioning uninterrupted by feeding (?) flights were clocked as follows on the indicated dates:

June 24	0824 to 0845	21 weevils in 21 minutes
	0852 to 0908	15 weevils in 16 minutes
	0935 to 1018	22 weevils in 43 minutes
June 25	0947 to 1013	23 weevils in 26 minutes
	1023 to 1030	7 weevils in 7 minutes
	1054 to 1110	13 weevils in 16 minutes
June 26	0824 to 0910	30 weevils in 46 minutes

The longest sustained period of hunting was the 46-minute span during which the wasp brought in 30 weevils.

I did not observe nesting activities at nest 62362 A on June 27, but I did note that the burrow entrance was open at 0820, 1250, and 1430.

At 1050 on June 27 I noted another female *blakei* (62762 B) fly into her nest 20 cm. E of 62362 A. I captured the wasp when she left the burrow, confirmed her identity, and released her. The nest was on a slight slope of bare sand, the burrow diameter at the entrance was 6 mm., and there was a low mound of excavated sand at the entrance. The entrance was still open at 1315, when I began to dig up the nest. I captured the female when she returned to the burrow 20 minutes later. There was a holding cell containing 45 *basalis* weevils about 10 cm. directly under the burrow entrance. Beneath the holding cell the burrow angled off at about 80° to the horizontal. There was only one cell in this nest, 23 cm. below the surface, and 13 cm. from a perpendicular line from the burrow entrance. It contained 70 *basalis* weevils and one small miltogrammine maggot. I could find no trace of the wasp egg; presumably it had been destroyed by the maggot. I continued this excavation to a depth of 30 cm. and a radius of 15 cm. but found no additional cells. The miltogrammine maggot finished feeding and pupated on the morning of July 1.

The entrance of 62362 A was closed all day on June 28, and was still closed the morning of June 29. I assumed that the wasp had made a final closure, so I dug up this nest at mid-morning on the 29th. The shallowest cell was 18 cm. below the surface and under the burrow entrance; it contained 69 *basalis,* some of which had been hollowed out, but no wasp egg or larva. The next cell was 22 cm. below the surface and 10 cm. WSW of a perpendicular line from the burrow entrance; I did not recover all of the prey fragments, but did collect one small black weevil, *Limnobaris confusa* (Boheman), 3.5 mm. long, and 13 entire *basalis* weevils, as well as 42 pairs of *basalis* elytra. Again, there was neither wasp egg nor larva, but many of the weevils had been hollowed out, presumably by miltogrammine maggots which had already left the cell. The deepest cell was at the 23–cm. level and 15 cm. WSW of a perpendicular line from the burrow entrance. I did not recover all the weevil fragments, but all were of *D. basalis* and included 51 whole weevils, many of which had been hollowed out, and 7 pairs of elytra. This cell, like the other two, presumably had been parasitized by Miltogrammini. I continued the excavation to a depth of 50 cm. and a radius of 30 cm. from the entrance, but I could find no other cells.

On June 30 I began making observations at the Arcadia site, 35 miles to the west. The emergence may have been somewhat later in this area, because there were a number of *blakei* males visiting flowers at Arcadia, whereas I had seen none of them at Lake Annie from June 22 to 29 or on July 5. At 1340 I captured a female *blakei* (63062 C) carrying a *basalis* weevil, and I released her after confirming her identity. Her burrow entrance, 3 mm. in diameter, was near a small prostrate plant on a slightly sloping sand bank. There was no spoil heap around the burrow entrance. This wasp continued to store weevils on July 1. Her burrow entrance was still open at 0845 on July 2, and again at 1015 when I began to dig up the nest. Apparently she had completed the nest, but did not fill in the entire burrow, because there was no trace of the main or lateral burrows below the 7–cm. level. This upper section of 7 cm. went downward at an angle of 60°. The shallowest cell was at the 22–cm. level, 10 cm. SE of a perpendicular line from the entrance; it contained 48 *basalis,* and 9 other weevils, *Anthonomus sexguttatus* Dietz, 2.3–2.5 mm. long; I did not recover the wasp egg and there was no evidence of infestation by Miltogrammini. The next cell was at the 24–cm. level, 10 cm. W of the perpendicular line from the entrance; it contained a miltogrammine maggot, 11 *basalis* and 31 *sexguttatus* weevils. The third cell was also at the 24–cm. level, 10 cm. WSW of the perpendicular line from the entrance; it contained a partially grown wasp larva, which I decapitated during the dig, and 25 pairs of elytra from two species of weevils, mostly *A. sexguttatus* but a few *Hyperodes* sp., and also the freshly dismembered parts of two chrysomelid beetles, *Graphops floridana* Blake, 4.5 mm. long. I continued this excavation to a depth of 30 cm. and a radius of 20 cm. from the entrance, but I found no other cells. Probably the Arcadia *blakei* were using other weevils in addition to *basalis,* because there were no palmetto blooms available to concentrate the *basalis.*

At 0835 on July 4 I found the nest of another *blakei* (7462 A), just a meter from that of 63062 C. The entrance was still open when I began to dig up this nest at 1230. I captured the wasp when she flew out of the nest 15 minutes later. The burrow had a diameter of 3.5 mm. at the entrance. It went downward at an angle of about 75° for 16.5 cm. At this point, 14.5 cm. below the surface, I found 4 *basalis* and 1 *sexguttatus* in the holding cell. The first cell which was only partially stored, was at the 18-cm. level, 12 cm. SE of a perpendicular line from the entrance. It contained 8 *basalis* and 8 *sexguttatus* weevils, and 1 chrysomelid, *Graphops floridana* Blake, 4 mm. long, but no wasp egg. I continued this excavation to a depth of 25 cm. and a radius of 20 cm. from the entrance, but found no other cells.

At 0900 I saw another *blakei* (7462 B) hunting around the base of a small plant. I captured her with her prey, just as she started to fly off with it. The latter was a tenebrionid beetle, *Blapstinus interruptus* (Say).

F. E. Kurczewski captured a female *blakei* on July 15, at Venus, several miles south of the Archbold Biological Station. She was carrying a *basalis* weevil.

Although I have recorded several specimens of Chrysomelidae and Tenebrionidae as prey of *blakei,* the available data clearly indicate a strong preference for Curculionidae. Perhaps beetles of other families are taken only (inadvertently?) when weevils are scarce.

Reference was made above to parasitism of *blakei* by miltogrammine flies. I never observed any of these flies trailing a prey-laden wasp to her burrow. However, on two successive mornings I saw from one to three of these flies perched on grass stems near the burrow of 62362 A observing the nesting activities. Subsequently, when this nest was excavated, each of the three cells contained hollowed-out specimens of prey whose appearance was consistent with infestation by miltogrammine maggots. Two of the cells from other nests (62762 B, 63062 C) which I dug up contained one miltogrammine maggot each. Of the seven completely provisioned cells which I recovered, apparently five had been parasitized by Miltogrammini.

Cerceris blakei belongs to the Rufinoda Group, which Banks (1947, p. 26) erroneously identified with the subgenus *Apiraptrix* Shestakov. Unfortunately we have no biological data on any of the species most closely related to *blakei.* As a matter of fact, there are only limited data on two other members of the Rufinoda Group, *rufinoda* Cresson and *finitima* Cresson as reported by Strandtmann (1945, pp. 311–312, figs. 9–10). These two species are the same size as *blakei.* Strandtmann found a partially stored cell of *rufinoda* in gravelly clay soil in Ohio; the steep burrow was about 9 cm. long and ended in a cell about 6 cm. beneath the surface containing 36 tiny, gray weevils, *Tychius picirostris* F. His nest of *finitima* was a partially stored, enlarged cell in sandy clay soil at the end of a vertical burrow about 5 cm. long; the cell contained 9 tiny black flea beetles, *Chaetocnema pulicaria* Melsh. The cells of these species were at a much shallower level than those of *blakei*. Since they were only partially stored, a possibility exists that each represented a holding cell rather than a cell in which an egg would be deposited. However, some species of *Cerceris* do nest at shallow depth: For example, *nigrescens* Smith, which Krombein (1938, pp. 1–2) reported as provisioning cells at depths of 2.5–7.5 cm.

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